The Management University of Africa

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UNDERGRADUATE UNIVERSITY EXAMINATIONS

SCHOOL OF MANAGEMENT AND LEADERSHIP

DEGREE BACHELOR OF EDUCATION ARTS

MTH 211: LINEAR ALGEBRA

DATE: 8TH APRIL 2026

DURATION: 2 HOURS

MAXIMUM MARKS: 70

INSTRUCTIONS:

1. Write your registration number on the answer booklet.
2. **DO NOT** write on this question paper.
3. This paper contains **SIX (6)** questions.
4. Question **ONE** is compulsory.
5. Answer any other **THREE** questions.
6. Question **ONE** carries **25 MARKS** and the rest carry **15 MARKS** each.
7. **Write all your answers in the Examination answer booklet provided.**

QUESTION ONE

a) Find the value of x if the following matrix is a non-invertible matrix

$$\begin{pmatrix} 2x-1 & 4 \\ x^2 & 4 \end{pmatrix}$$ **(4 marks)**

b) Reduce to echelon form and determine the row-rank of $A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 2 & 4 & 6 & 8 \\ 3 & 6 & 9 & 12 \\ 3 & 1 & 1 & -1 \end{bmatrix}$ **(7 marks)**

c) Verify whether the given vectors U = (1, 0, 0, 3), **V**= (0, 1, -2, 0), **W**= (0, -1, 1, 1) are linearly independent **(8 marks)**

d) Use Crammer's Rule to solve the system of equations given below:

x + 2y - z = 2

3x + y + z = 5

4x + y + 3z = 8 **(6 marks)**

QUESTION TWO

a) Use the Gauss-Jordan reduction to solve the following systems of linear equations

2x + y - 2 z = 10

3x + 2y - 2z = 1

5x + 4y + 3z = 4 **(6 marks)**

b) Verify that if $M = \begin{bmatrix} -5 & 10 & 8 \\ 4 & -7 & -6 \\ -3 & 6 & 5 \end{bmatrix}$ and $N = \begin{bmatrix} -1 & 2 & 4 \\ 2 & 1 & -2 \\ -3 & 0 & 5 \end{bmatrix}$, then MN=NM =I where I is the 3 x 3 unit matrix.

Use this to solve the matrix equation $\begin{bmatrix} -5 & 10 & 8 \\ 4 & -7 & -6 \\ -3 & 6 & 5 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} -3 \\ 3 \\ 2 \end{bmatrix}$

(9 marks)

QUESTION THREE

Find the minors and the cofactors of matrix A = $\begin{pmatrix} 1 & 2 & 3 \\ 4 & 3 & 2 \\ 1 & 0 & 3 \end{pmatrix}$ and hence the inverse of matrix A **(15 marks)**

QUESTION FOUR

a) Find the points of intersection of the planes

$-x + 2y + 3z = -2$

$2x - 4y - 6z = 4$

$x - 2y - 3z = 2$ **(8 marks)**

b) Write (8, 8, 12) in E^3 as a linear combination of (2, 1, 3), (4, 2, 6) and (6, 4, 9)

(7 marks)

QUESTION FIVE

a) Find the basis and the dimensions if the solution space for the equations given below

$2x - 2y + 3z = 0$

$-x + 3y - 2z = 0$

$x + y + z = 0$

(9 marks)

b) Show that the vector S = {(1, 0, 0), (0, 1, 0), (0, 0, 1)} is a basis for R^3 **(6 marks)**

QUESTION SIX

a) T: $R^4 \rightarrow R^3$ is defined by T(x) = $\begin{bmatrix} 2 & 0 & -1 \\ 4 & 0 & -2 \\ 0 & 0 & 0 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix}$.

Find i) basis for Ker (T)

ii) basis for R(T)

iii) Rank (T), nullity (T) **(12 marks)**

b) T: $R^3 \rightarrow R^2$ is defined by T$\begin{bmatrix} x \\ y \\ z \end{bmatrix}$ = $\begin{bmatrix} 2x+y \\ 3x-y+z \end{bmatrix}$. Find matrix representing T. **(3 marks)**

MTH 211
Tables and Formulae

1) Linear combination, S = $k_1v_1 + k_2v_2 + k_3v_3$ + -----------+ k_nv_n
2) Linearly independent, $k_1v_1 + k_2v_2 + k_3v_3$ + -----------+ $k_nv_n = 0$
3) Homogeneous equation AX = 0